

HOSKINS-WESTERN-SONDEREGGER INC LINCOLN NE F/G 13/13
NATIONAL DAM SAFETY PROGRAM. STRUCTURE NUMBER 1 - WILLIAMS CREE--ETC(U)
AUG 78 H P HOSKINS DACW43-78-C-0155

DACW43-78-C-0155
NL

1 of 1
AD 4
125,649

END
DATE
FILMED
11-81
DTIC

MISSOURI **LEVEL** **1**
MISSOURI-KANSAS CITY BASIN

AD A105648

STRUCTURE NO. 1 - WILLIAMS CREEK

CLAY COUNTY, MISSOURI

MO 10728

9 Final rept., /

15 DACW43-78-C-0155

10 Harold P. / Hoskins

6 **PHASE 1 INSPECTION REPORT**
NATIONAL DAM SAFETY PROGRAM.

Structure Number 1 - Williams Creek Dam
(MO 10728), Missouri - Kansas City Basin,
Clay County, Missouri. Phase I Inspection
Report.

DTIC FILE COPY



DTIC
ELECT
S OCT 16 1981
D

PREPARED BY: HOSKINS-WESTERN-SONDEREGGER, INC.

FOR: STATE OF MISSOURI

11 AUG 1978

81 10 15

DISTRIBUTION STATEMENT A

Approved for public release;
Distribution Unlimited

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER	2. GOVT ACCESSION NO. <i>AD-A105648</i>	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Phase I Dam Inspection Report National Dam Safety Program Structure #1 Williams Creek (MO 10728) Clay County, Missouri		5. TYPE OF REPORT & PERIOD COVERED Final Report
7. AUTHOR(s) Hoskins-Western-Sonderegger, Inc.		6. PERFORMING ORG. REPORT NUMBER
9. PERFORMING ORGANIZATION NAME AND ADDRESS U.S. Army Engineer District, St. Louis Dam Inventory and Inspection Section, LMSED-PD 210 Tucker Blvd., North, St. Louis, Mo. 63101		8. CONTRACT OR GRANT NUMBER(s) DACW43-78-C-0155
11. CONTROLLING OFFICE NAME AND ADDRESS U.S. Army Engineer District, St. Louis Dam Inventory and Inspection Section, LMSED-PD 210 Tucker Blvd., North, St. Louis, Mo. 63101		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		12. REPORT DATE August 1978
		13. NUMBER OF PAGES Approximately 35
		15. SECURITY CLASS. (of this report) UNCLASSIFIED
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT (of this Report) Approved for release; distribution unlimited.		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Dam Safety, Lake, Dam Inspection, Private Dams		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This report was prepared under the National Program of Inspection of Non-Federal Dams. This report assesses the general condition of the dam with respect to safety, based on available data and on visual inspection, to determine if the dam poses hazards to human life or property.		

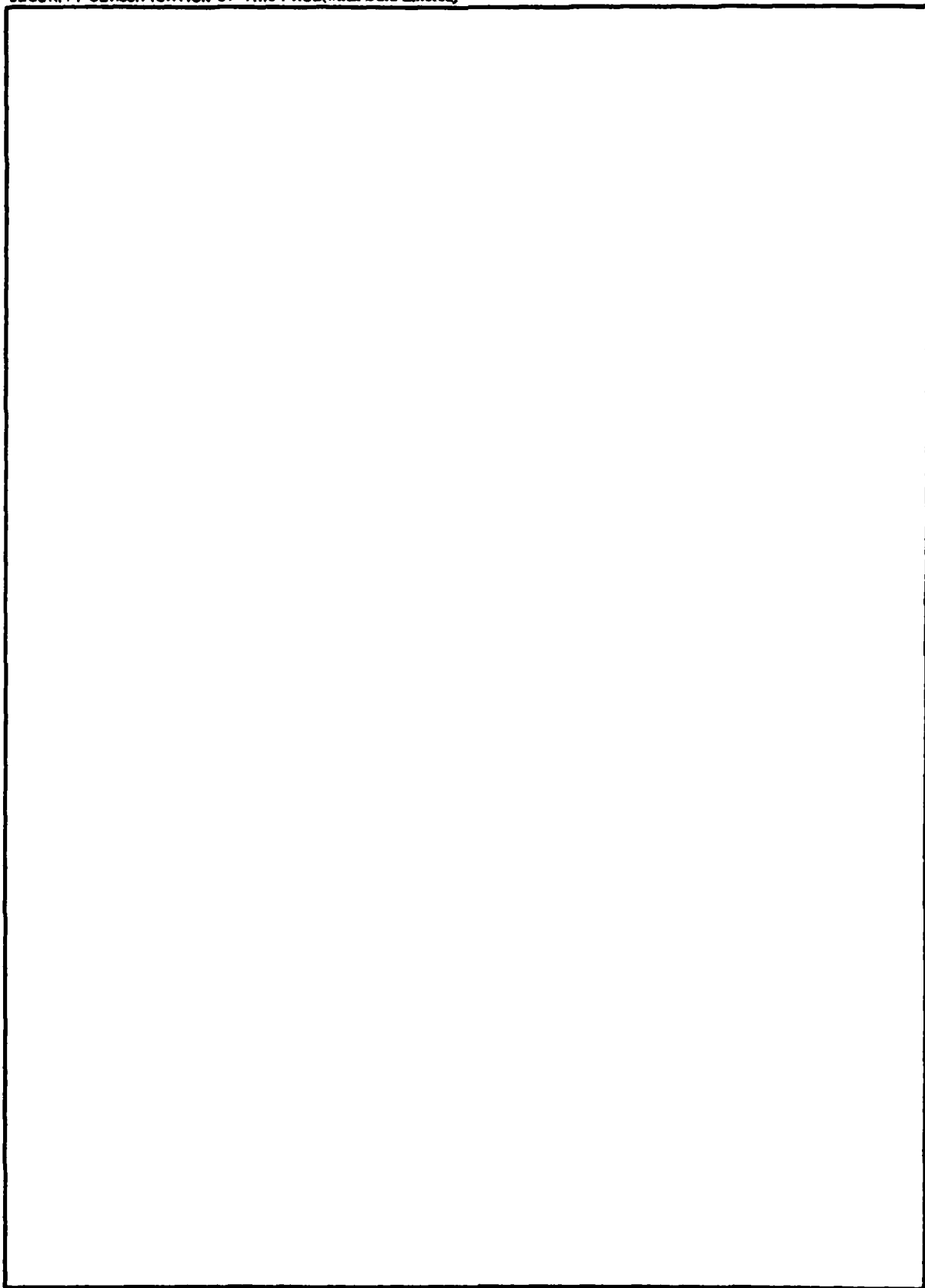
DD FORM 1 JAN 73 1473

EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

SECURITY CLASSIFICATION OF THIS PAGE(When Data Entered)



SECURITY CLASSIFICATION OF THIS PAGE(When Data Entered)



DEPARTMENT OF THE ARMY
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
210 NORTH 12TH STREET
ST. LOUIS, MISSOURI 63101

IN REPLY REFER TO

SUBJECT: Structure No. 1 - Williams Creek Phase I Inspection Report

This report presents the results of field inspection and evaluation of Structure No. 1 - Williams Creek:

It was prepared under the National Program of Inspection of Non-Federal Dams.

This dam has been classified as unsafe, non-emergency by the St. Louis District as a result of the application of the following criteria:

- 1) Spillway will not pass 50 percent of the Probable Maximum Flood
- 2) Overtopping could result in dam failure.
- 3) Dam failure significantly increases the hazard to loss of life downstream

SUBMITTED BY:

SIGNED

Chief, Engineering Division

28 SEP 1978

Date

APPROVED BY:

Colonel, CE, District Engineer

29 SEP 1978

Date

Accession For	
NTIS	X
DTIC TAB	
Unannounced	
Justification	
By	
Distribution/	
Availability Codes	
Dist	Avail and/or Special
A	

DTIC
ELECTE
OCT 16 1981
D

PHASE I REPORT

NATIONAL DAM SAFETY PROGRAM

Name of Dam	Structure No. 1 - Williams Creek
State Located	Missouri
County Located	Clay County
Stream	Tributary to Williams Creek
Date of Inspection	August 4, 1978

Structure No. 1 - Williams Creek was inspected by an interdisciplinary team of engineers. ~~from Hoskins-Western-Sonderegger, Inc.~~ The purpose of the inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and visual inspection, in order to determine if the dam poses hazards to human life or property.

The guidelines used in the assessment were furnished by the Department of the Army, office of the Chief of Engineers and developed with the help of several Federal and State agencies, professional engineering organizations, and private engineers. Based on these guidelines, this dam is classified as a small size dam with a high downstream hazard potential. Failure would threaten life and property. The estimated damage zone extends five miles downstream of the dam. Within the damage zone are three homes, one county road and one state highway.

Our inspection and evaluation indicates that the spillway does not meet the criteria set forth in the guidelines for a dam having the above size and hazard potential. The spillway will pass the 100-year frequency storm and also the storm equal to 29% of the Probable Maximum Flood without overtopping the dam. The Probable Maximum Flood (PMF) is defined as the flood that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region. Additional deficiencies, in accordance with the guidelines, are the lack of seepage and stability analysis. These analyses should be obtained in the future.

Other deficiencies visually observed by the inspection team were a few small trees growing on the upstream embankment slope, some erosion of the downstream berm and low spots in the crest of the dam where water ponds.

Several items of preventive maintenance need to be initiated by the owner. These are described in detail in the body of the report. Copies of the report have been furnished the dam owner and the Governor of Missouri.

SUBMITTED BY

A
SIGNED

Chief, Engineering Division

APPROVED BY

Colonel, CE, District Engineer

H.P. Hoskins E 8696
Harold P. Hoskins, P.E.
Hoskins-Western-Sonderegger, Inc.
Lincoln, Nebraska

28 SEP 1978

Date

29 SEP 1978

Date



PHOTO NO. 1 OVERVIEW-DAM IN UPPER BACKGROUND

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
STRUCTURE NO. 1 - WILLIAMS CREEK - MO 10728

TABLE OF CONTENTS

<u>Paragraph No.</u>	<u>Title</u>	<u>Page No.</u>
SECTION 1 - PROJECT INFORMATION		
1.1	General	1
1.2	Description of Project	1
1.3	Pertinent Data	2
SECTION 2 - ENGINEERING DATA		
2.1	Design	5
2.2	Construction	5
2.3	Operation	5
2.4	Evaluation	5
SECTION 3 - VISUAL INSPECTION		
3.1	Findings	6
3.2	Evaluation	7
SECTION 4 - OPERATIONAL PROCEDURES		
4.1	Procedures	8
4.2	Maintenance of Dam	8
4.3	Maintenance of Operating Facilities	8
4.4	Description of Any Warning System in Effect	8
4.5	Evaluation	8
SECTION 5 - HYDRAULIC/HYDROLOGIC		
5.1	Evaluation of Features	9
SECTION 6 - STRUCTURAL STABILITY		
6.1	Evaluation of Structural Stability	11
SECTION 7 - ASSESSMENT/REMEDIAL MEASURES		
7.1	Dam Assessment	12
7.2	Remedial Measures	12

APPENDIX A - MAPS

Plate 1	Vicinity Topography
Plate 2	Location Map

APPENDIX B - PHOTOGRAPHS

Photographs of Dam and Lake (No. 2 through No. 16)

APPENDIX C - PLANS AND REPORTS

Sheet 4 of 19 (SCS)	Centerline Section
SCS	Soil Mechanics Report

APPENDIX D - HYDROLOGIC COMPUTATIONS

Plate D1	Inflow Hydrographs - 1/2 PMF and PMF
----------	--------------------------------------

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

a. Authority. The National Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of safety inspection of dams throughout the United States. Pursuant to the above, the St. Louis District, Corps of Engineers, District Engineer directed that a safety inspection of the Structure No. 1 - Williams Creek be made.

b. Purpose of Inspection. The purpose of the inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and visual inspection, in order to determine if the dam poses hazards to human life or property.

c. Evaluation Criteria. Criteria used to evaluate the dam were furnished by the Department of the Army, Office of the Chief of Engineers, in "Recommended Guidelines for Safety Inspection of Dams". These guidelines were developed with the help of several Federal agencies and many State agencies, professional engineering organizations, and private engineers.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances.

(1) This dam is an earth fill located on an unnamed subtributary of Williams Creek, approximately 2000 feet upstream from its confluence with a larger tributary. The larger tributary is dammed approximately 5000 feet upstream from this confluence. The quadrangle map on Plate 1 shows the location of Williams Creek Watershed Structure No. 1.

(2) The principal spillway consists of an uncontrolled 30-inch diameter reinforced concrete pipe located at about $\frac{1}{4}$ station 7+12.

(3) An uncontrolled emergency spillway is cut into the left (east) abutment.

(4) Pertinent physical data are given in paragraph 1.3, below.

b. Location. The dam is located in the northeast portion of Clay County, Missouri, as shown on Plate 2. The dam and the lake it forms are located in the SE $\frac{1}{4}$ of Section 21, T53N, R30W, as shown on Plate 1.

c. Size Classification. Criteria for determining the size classification of dams and impoundments are presented in the guidelines referenced in paragraph 1.1c above. Based on these criteria, this dam and impoundment is in the small size category.

d. Hazard Classification. Guidelines for determining hazard classification are presented in the same guidelines as referenced in paragraph c above. Based on referenced guidelines, this dam is in the High Hazard Classification. The estimated damage zone extends five miles downstream of the dam. Within the damage zone are three homes, one county road, and one state highway.

e. Ownership. This dam is located on property owned by Jane L. Angle, 6439 Overbrook Road, Shawnee Mission, Kansas 66208.

f. Purpose of Dam. The primary purpose is as a flood retarding structure.

g. Design and Construction History. The as-built plans for the structure show that it was designed in 1970 by the Soil Conservation Service and that construction was completed in 1971.

h. Normal Operating Procedure. The primary and emergency spillways are uncontrolled. There was no indication that the emergency spillway had ever operated.

1.3 PERTINENT DATA

a. Drainage Area - 1,051 acres (1.642 sq. mi.).

b. Discharge at Damsite.

(1) All discharge at the damsite is through an uncontrolled reinforced concrete drop inlet pipe (1' x 2.5' rectangular opening) principal spillway and a grassed earth channel ungated emergency spillway.

(2) Estimated maximum flood at damsite - unknown.

(3) The principal spillway capacity varies from 0 c.f.s. at elevation 854.5 feet to 39 c.f.s. at the crest of the emergency spillway (865.6 feet).

(4) The principal spillway capacity at maximum pool elevation (868.2 feet) is 44 c.f.s. Maximum pool elevation is that design value for freeboard pool level as furnished on SCS as-built plans.

(5) The emergency spillway capacity at maximum pool elevation is 670 c.f.s.

(6) The total spillway capacity at maximum pool elevation is 714 c.f.s.

c. Elevations (Feet above M.S.L.).

- (1) Top of dam - 869.2 (SCS plans) - 869.6 (survey 4 August 1978).
- (2) Principal spillway crest - 854.5.
- (3) Emergency spillway crest - 865.6.
- (4) Streambed at centerline of dam - 834 ±.
- (5) Maximum tailwater - unknown.

d. Reservoir. Length of maximum pool - 3,000 ±.

e. Storage (Acre-feet). Top of dam (869.2) - 530. Normal Pool (854.5) - 91.

f. Reservoir Surface (Acres).

- (1) Top of dam - 40 ±.
- (2) Spillway crest - 30 ±.

g. Dam.

- (1) Type - earth embankment.
- (2) Length - 1140 feet ±.
- (3) Height - 35 feet ±.
- (4) Top width - 14 feet ±.
- (5) Side slopes -
 - (a) Downstream - 2 1/2H:1V.
 - (b) Upstream - exposed section 2:1 to 854.5; 19-foot horizontal berm (at permanent pool elevation). Plans show 2 1/2:1 below berm.
- (6) Zoning - Unknown. None shown on plans.
- (7) Impervious Core - Unknown. None shown on plans.
- (8) Cutoff - Unknown. Plans show core trench to rock within area of permanent pool. Width shown is variable, nominally 16 feet at the bottom. Depth is variable, side slopes 1:1.
- (9) Grout curtain - Unknown.
- (10) Riprap - None.

- h. Diversion and Regulation. None.
- i. Spillway.
 - (1) Principal.
 - (a) Type - Uncontrolled reinforced concrete drop inlet with rectangular weir/orifice inlet and a 30 inch reinforced concrete pressure pipe.
 - (b) Size of weir/orifice - 1 ft. x 2.5 ft., rectangular.
 - (c) Crest elevation - 854.5 feet M.S.L.
 - (2) Emergency.
 - (a) Type - Standard SCS grassed earth channel.
 - (b) Control section - 60-foot bottom width; 3(h):1(v) side slopes.
 - (c) Crest elevation - 865.6 feet M.S.L.
 - (d) Upstream channel - 120° curve in channel with heavy grass in good condition.
 - (e) Downstream channel - heavy grass in good condition.
- j. Regulating Outlet.
 - (1) Principal Spillway.
 - (a) Reinforced concrete inlet with 16-inch diameter R/C pipe (invert elevation 845.5 feet).
 - (b) 16-inch diameter rising stern slide gate and 24-inch removable handwheel with lift (see as-built plans). Not considered in computations.
 - (2) Emergency Spillway - None.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

Data on the geologic investigation, hydraulic/hydrologic computations, construction plans, and the soil mechanics/soil engineering report were supplied by the Soil Conservation Service, Columbia, Missouri. This information is shown in Appendix C.

2.2 CONSTRUCTION

No construction data were readily available; however, it is reported that the dam was constructed with SCS engineering supervision and standard inspection and quality control procedures.

2.3 OPERATION

No information was available on the operation of the spillways. The emergency spillway appears never to have operated.

2.4 EVALUATION

- a. Availability. The engineering data shown in Appendix C was readily available from the SCS, Columbia, Missouri.
- b. Adequacy. The available data and reported information seems to be adequate to assess the design and stability of the structure.
- c. Validity. The available data and analyses conform with accepted practice.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General. A visual inspection of Structure No. 1 - Williams Creek was made on August 4, 1978. Engineers from Hoskins-Western-Sonderegger, Inc., Lincoln, Nebraska who made the inspection were: Stephen H. Nickel, Geology and Soil Mechanics, Garold Ulmer, Civil Engineer and Allen Jambor, Hydrology. Specific observations are discussed below.

b. Dam. The upstream and downstream slopes are well-vegetated with grasses. Rough measurements along the crest of the dam indicate several places where the elevations are lower than the ends of the dam. Several of these low areas are ponding water for long periods of time. Tadpoles were noted in several of the ponds. Deep ruts have been formed by vehicles moving through these areas.

No cracks, slides, or abnormal lateral deformations were noted in the embankment. No seepage was apparent on the downstream slope nor along the toe of the dam. Neither slides nor seepage was noted in the abutments. Material in the abutments consists of CL or CH soils.

Surface materials in the dam consist of CL soils. A few small trees were observed along the upstream slope.

There was no indication of the emergence of the phreatic line or other seepage on the downstream slope or along the toe of the dam.

Rough measurements of the profiles of the crest of the dam and the emergency spillway and of the cross section of the embankment and spillway indicate that the dam was constructed according to the plans shown in Appendix C.

A small erosion gully, about 1 foot deep, was found along the upstream side of the berm on the downstream slope, along the right abutment.

c. Appurtenant Structures.

(1) Principal Spillway. The principal spillway consists of a 30-inch reinforced concrete pipe, with pressure joints, passing through the dam at about station 7+12. The inlet consists of a 3 1/2-foot square closed-top riser with a 2 1/2-foot by 1-foot rectangular orifice, protected by a trash rack. There were no indications of spalling or deterioration of the principal spillway riser nor of the concrete pipe outlet. The outlet end of the pipe is supported about 3 feet above a riprap lined plunge pool. There is no evidence of erosion of the plunge

pool. The lake level was at the spillway crest elevation at the time of the inspection.

(2) Emergency Spillway. The emergency spillway is well-vegetated with adapted grasses. It looked very good with no evidence of erosion in the bottom or on the side slopes.

(3) Drawdown Facility. The plans show a 16-inch concrete draw-down pipe with a handwheel-operated slide gate, mounted in the riser. This system is designed to evacuate the reservoir. It is not known whether this system is operable.

d. Reservoir Area. No wave wash or slides were observed along the shore of the reservoir. Slight erosion was noted along both the left and right shorelines starting at the dam and extending about 1000 feet upstream.

e. Downstream Channel. The channel downstream from the principal spillway is poorly defined for approximately 2000 feet. In this reach it is badly clogged by trees and brush and crossed by at least one fence.

3.2 EVALUATION

None of the conditions observed indicate a need for immediate remedial action. Trees on the upstream slope, erosion on the downstream berm, and water ponding on the crest are deficiencies which could ultimately impair the integrity of the dam if left uncontrolled or uncorrected.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

The pool level is normally controlled by rainfall, runoff, evaporation and capacity of the uncontrolled spillways. Procedures for operating the drawdown facility are not known.

4.2 MAINTENANCE OF DAM

The dam is reasonably well maintained. Action should be taken to correct the minor deficiencies noted in Sections 3 and 7.2.

4.3 MAINTENANCE OF OPERATING FACILITIES

It is not known if the drawdown facility is operable nor if and when the system has been operated.

4.4 DESCRIPTION OF WARNING SYSTEM IN EFFECT

The inspection team is not aware of any existing warning system for this dam.

4.5 EVALUATION

The dam and appurtenances appear to be well maintained with the exception of some laxity in controlling tree growth on the upstream face and allowing erosion on the downstream berm.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

a. Design Data. Pertinent hydraulic and hydrologic data which were taken from as-built plans furnished by the SCS are tabulated in Appendix D as Hydrologic Computations. The supporting computations are attached.

b. Experience Data. The drainage area and elevation-storage were taken from the SCS as-built plans. The reservoir water surface areas were developed from the USGS Holt 7 1/2" quadrangle. The hydraulic computations for spillways and dam overtopping discharge ratings were based on the data taken from the as-built plans. Surveys made during the field inspection revealed no major discrepancies as far as the structural components of the dam and spillways were concerned.

A railroad grade divides the drainage area. Approximately 75% of the contributing drainage area lies upstream from the railroad grade. The contributing stream passes under the railroad through a 12 ft. x 12 ft. R/C box culvert approximately 200 ft. long. The effect of the railroad grade and culvert were not considered in the original plans as furnished by the SCS so were not considered in this evaluation.

c. Visual Observations.

(1) Principal and emergency spillways are in good condition.

(2) The emergency spillway does not appear to have ever been used.

(3) The emergency spillway and exit channel are in the left hillside at the end of the dam. Spillway use should not endanger the integrity of the dam.

d. Overtopping Potential. The spillways are too small to pass the probable maximum flood without overtopping. One-half the PMF will overtop the dam a maximum of 0.88 ft. and for a period of 2.75 hours. The spillways will pass the 0.29 PMF without overtopping the dam. The existing spillways will pass the 24-hour 100-year frequency flood without overtopping. The results of the routings through the dam are tabulated in regards to the following conditions.

<u>Frequency</u>	<u>Peak Inflow Discharge c.f.s.</u>	<u>Peak Outflow Discharge c.f.s.</u>	<u>Maximum Pool Elevation</u>	<u>Freeboard Top of Dam Min. Elev. 869.2</u>	<u>Time Dam Overtopping Hrs.</u>
100-Yr.	2000	700	868.2	+1.0	-
1/2 PMF	4700	4600	870.1	-0.9	2.8
PMF	9400	9400	870.8	-1.6	5.5
0.29 PMF	2700	1500	869.2	0	-

According to the recommended guidelines from the Department of the Army, Office of the Chief of Engineers, this dam is classified as having a high hazard rating and a small size. Therefore, the PMF is the test for the adequacy of the dam and its spillways.

The St. Louis District, Corps of Engineers, in a letter dated 13 July, 1978 has estimated the damage zone as extending five miles downstream from the dam. Within the damage zone are three homes, one county road, and one state highway. This fact was verified by field inspection.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations. Maintenance features that could affect the long time safety of the dam are discussed in Section 3.2.

b. Design and Construction Data. The engineering data, analyses, and plans supplied by the SCS conform with accepted practice and are considered adequate to assess the structural stability of the dam.

There is no reason to question the adequacy of construction supervision and quality control.

c. Operating Records. There are no appurtenant structures that require operational functions.

d. Post Construction Changes. The inspection party is not aware of any post construction changes.

e. Seismic Stability. This dam is located in the Zone 1 seismic probability classification area. An earthquake of this magnitude is not expected to cause structural failure of this dam.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety. The few deficiencies in maintenance that were observed, a few small trees, minor erosion on the downstream berm, and water ponding on the crest, should be corrected and/or controlled. The probable maximum flood (PMF) will overtop the dam, however, the spillways are adequate to pass the flood resulting from 29% of the PMF without overtopping. The dam is designed to impound the flood resulting from the storm that has a 1 percent (1 in 100 years) chance of occurrence without flow in the emergency spillway.

b. Adequacy of Information. The information presented in this report is considered adequate to assess the safety of the structure. Neither seepage nor stability analysis were found which is a deficiency that should be corrected in the future. Lack of information as to whether the 16" concrete pipe drawdown facility is operable is a deficiency.

c. Urgency. There is no immediate urgency to accomplish the remedial measures discussed in paragraph 7.2.

d. Necessity for Phase II. Based on the results of the Phase I inspection, Phase II investigations are not considered necessary.

e. Seismic Stability. The dam is located in Seismic Zone 1. An earthquake of this magnitude is not expected to be hazardous to this dam.

7.2 REMEDIAL MEASURES

a. Alternatives. The size of the spillway could be enlarged to pass the probable maximum flood.

b. Operation and Maintenance and Procedures.

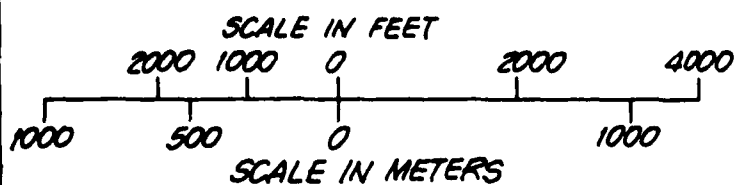
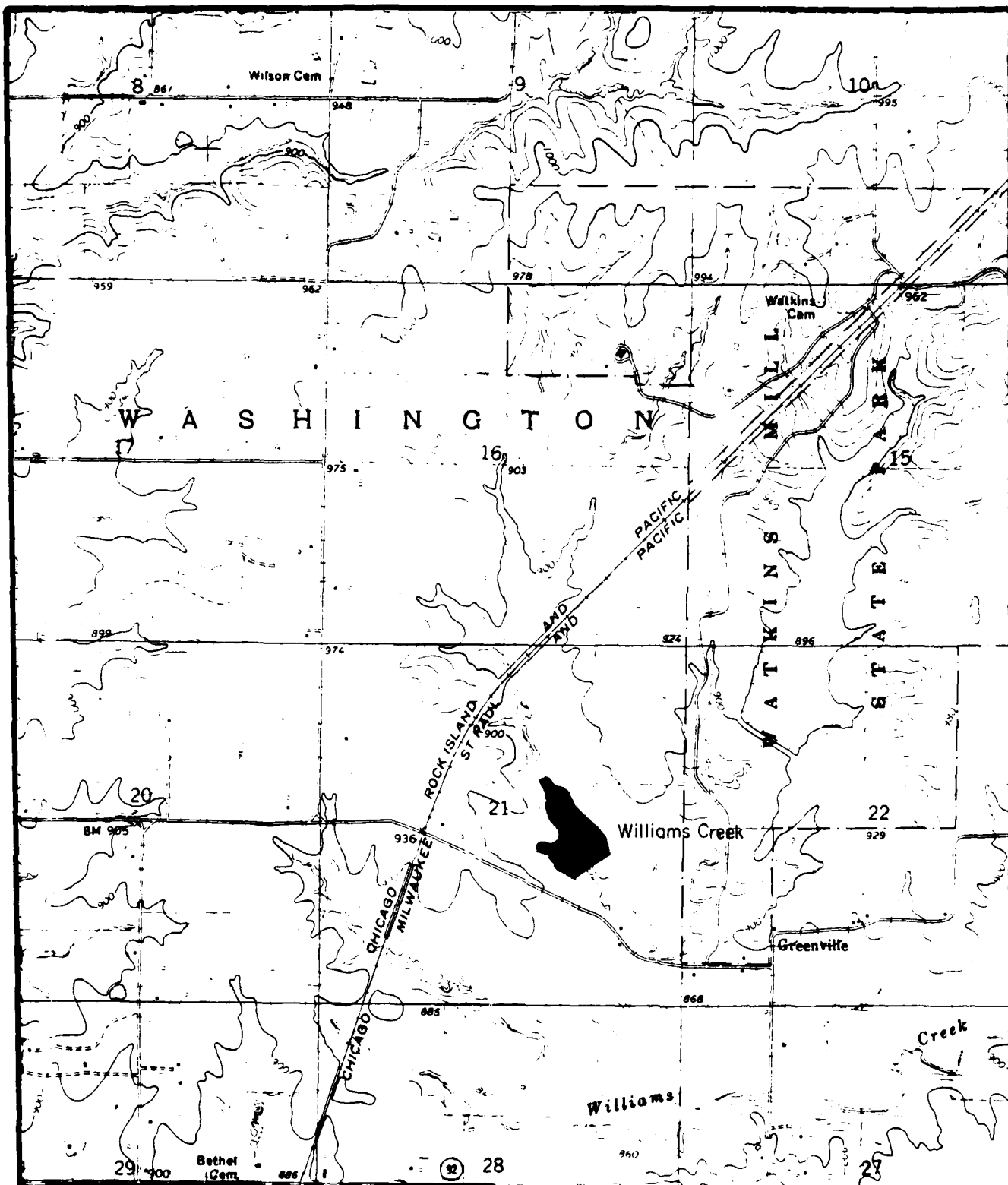
(1) The crest of the dam should be regraded to the elevation and transverse slope shown on the plans. This will eliminate the locations where water is currently ponding.

(2) If it is necessary to cross the dam in all types of weather, the crest should be gravelled to provide an all-weather surface.

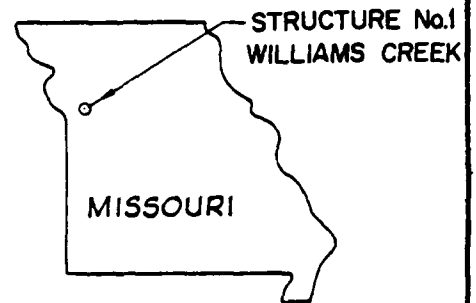
(3) Erosion damage should be repaired where the downstream toe ditch joins the berm in the right abutment. The installation of some type of ditch check or ditch lining is recommended.

(4) The trees should be removed from the upstream face of the dam, with measures instituted to prevent recurrence.

APPENDIX A
MAPS

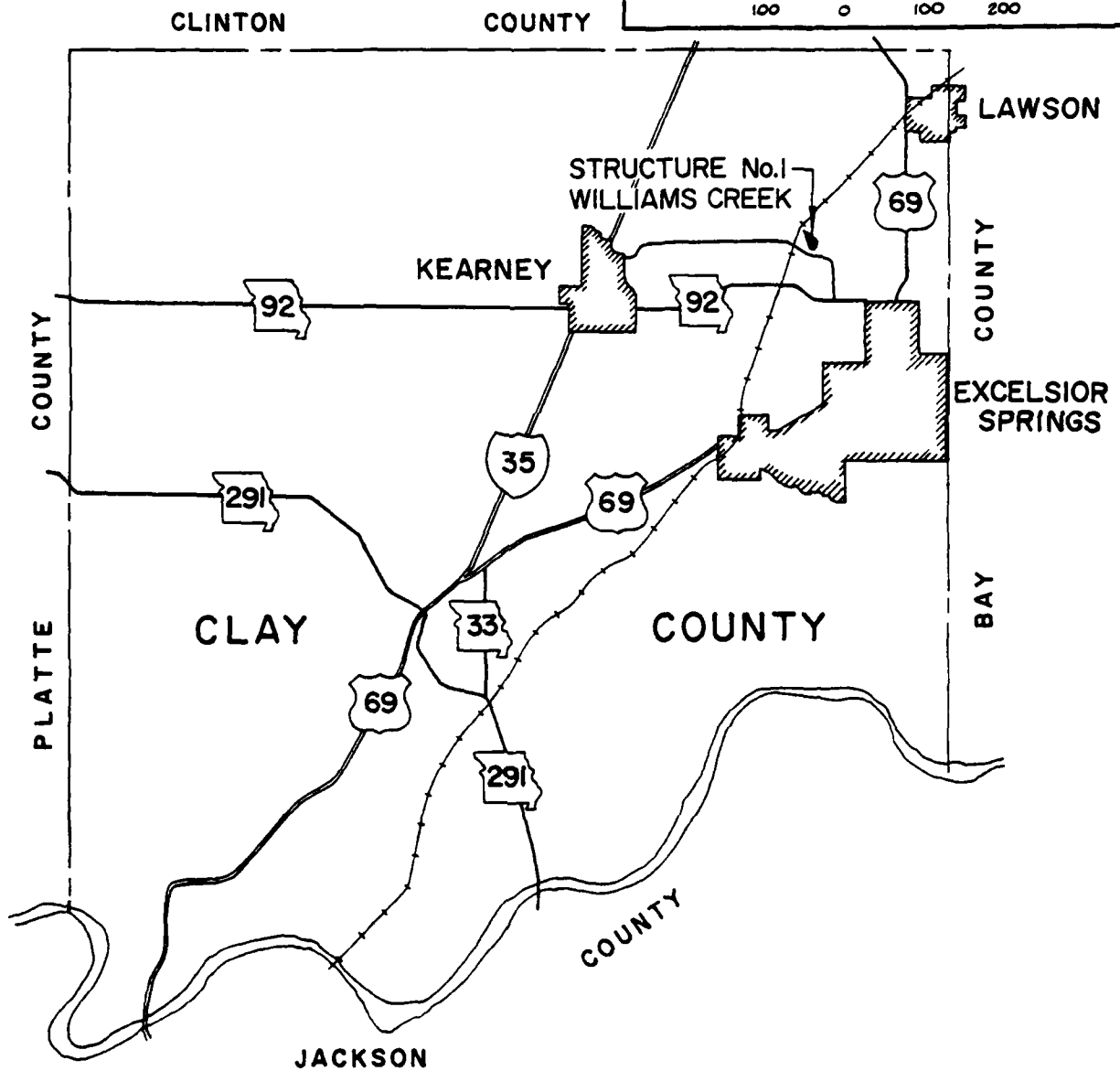
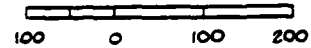


STRUCTURE No. 1
WILLIAMS CREEK
VICINITY TOPOGRAPHY
PLATE 1



VICINITY MAP

SCALE IN MILES



SCALE IN MILES



LOCATION MAP
PLATE 2

APPENDIX B
PHOTOGRAPHS



PHOTO NO. 2
UPSTREAM SLOPE
FROM RIGHT
ABUTMENT



PHOTO NO. 3
DOWNSTREAM SLOPE
FROM RIGHT
ABUTMENT



PHOTO NO. 4
LOOKING DOWNSTREAM
FROM TOP OF DAM

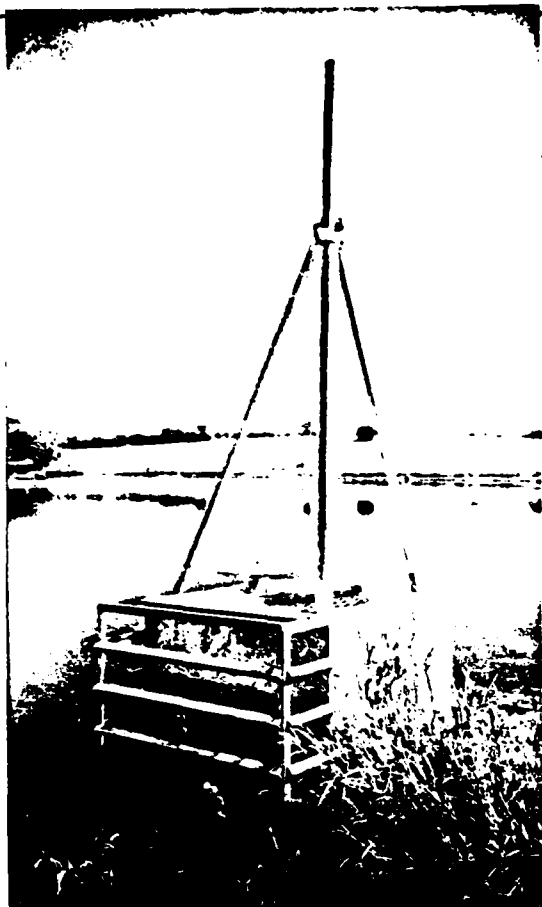


PHOTO NO. 5
PRINCIPAL SPILLWAY
INLET



PHOTO NO. 6
PRINCIPAL SPILLWAY
OUTLET, PLUNGE POOL,
AND CHANNEL

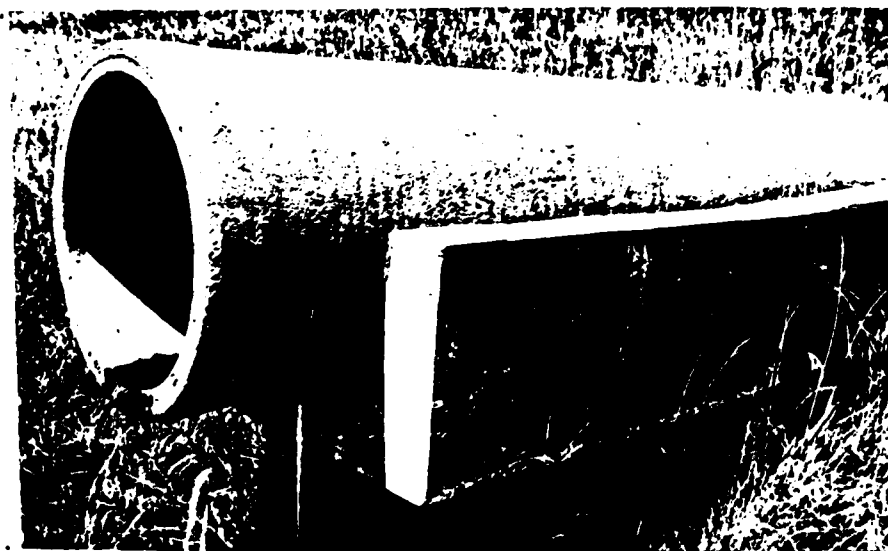


PHOTO NO. 7
PRINCIPAL SPILLWAY
OUTLET



PHOTO NO. 8
OUTLET CHANNEL
AT PROPERTY
LINE



PHOTO NO. 9
CREST ABOUT STA. 5+50.
WATER IN LOW AREA
AND IN RUT



PHOTO NO. 10
UPSTREAM SLOPE
FROM LEFT
ABUTMENT



PHOTO NO. 11
RIGHT SHORE
OF RESERVOIR
FROM DAM



PHOTO NO. 12
RIGHT SHORE
CLOSEUP OF
BANK EROSION



PHOTO NO. 13
LEFT SHORE
OF RESERVOIR
FROM DAM



PHOTO NO. 14
LEFT SHORE
CLOSEUP OF
BANK EROSION



PHOTO NO. 15
EMERGENCY SPILLWAY
FOREBAY FROM
NEAR DAM
CENTERLINE



PHOTO NO. 16
EMERGENCY SPILLWAY
OUTLET FROM
NEAR DAM
CENTERLINE

APPENDIX C
PLANS AND REPORTS

UNITED STATES GOVERNMENT

*Memorandum*U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

TO : James M. Dale, State Conservation Engineer,
SCS, Columbia, Missouri

DATE: November 12, 1968

FROM : Lorn P. Dunnigan, Head, Soil Mechanics Laboratory,
SCS, Lincoln, Nebraska

SUBJECT: ENG 22-5, Missouri WP-08, Williams Creek, Site No. 1 (Clay County)

ATTACHMENTS

1. Form SCS-354, Soil Mechanics Laboratory Data, 1 sheet.
2. Form SCS-352, Compaction and Penetration Resistance Report, 5 sheets.

DISCUSSIONFOUNDATION

- A. Bedrock: The bedrock is reported to be limestone and shale in the lower Kansas City Group of the Pennsylvanian System, and is reported to be sound.

The bedrock is overlain by CL till in both abutments and medium to stiff alluvium in channel section. The alluvium and till are reported to be at very low permeability.

- B. Strength: No undisturbed samples were submitted from this site. However, the geologist reports that the foundation is believed to be competent in its entirety.

EMBANKMENT

- A. Classification: The five borrow samples submitted are classed as CL with liquid limits ranging from 36 to 47 and PI's ranging from 12 to 25.

- B. Compacted Density: Standard Proctor compaction tests were made on all five borrow samples. The sample from the emergency spillway has a dry density of 101.0 pcf and the other four samples have dry densities ranging from 98.0 to 103.0 pcf.

- C. Strength: No shear tests were made on borrow samples from this site.

SLOPE STABILITY

Slope stability analyses were not made on this site. However, higher embankments in this watershed have been stable with 2 1/2:1 slopes.

2 -- James M. Dale -- 11/12/68

Lorn P. Dunnigan

Subj: ENG 22-5, Missouri WP-08, Williams Creek, Site No. 1

RECOMMENDATIONS

- A. Site Preparation: Normal site preparation as suggested by project engineer is expected to be adequate.
- B. Cutoff Trench: The cutoff trench may be shallow in the abutments. As is suggested by the project engineer, there may be unsealed layers of cobbles and rubbles above the bedrock. There is the possibility of overhangs on the bedrock surface. Therefore, we suggest that the core trench bottom on bedrock from approximately station 8+50 to 14+10. When the trench is open we suggest the bedrock be inspected for overhangs and any that are found be reshaped to insure a tight soil to bedrock contact.
- C. Principle Spillway: The foundation alluvium is reported to be medium to stiff in density. With the loads of this height embankment settlement is expected to be low.
- D. Drain: Near positive cutoff is anticipated with cutoff trench depths suggested and a drain is not considered necessary for stability of the embankment.

E. Embankment Design:

- 1. Placement of Materials: The borrow material may be placed anywhere in the fill but we suggest the lower plasticity material be used as blanketing to reduce the possibility of surface drying cracks.

The reference embankment strength parameters are from Williams Creek Sites 2 and 4 and they are for materials compacted to 95 percent of standard Proctor density. Therefore, we recommend placement of embankment materials at a minimum of 95 percent Proctor density with moisture controlled near optimum.

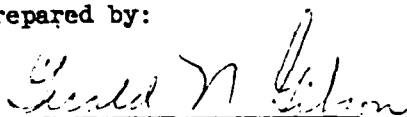
- 2. Slopes: With the embankment at 95 percent of Proctor, the proposed 2 1/2:1 slopes are expected to be stable.
- 3. Settlement: An overfill allowance of 0.5 foot is suggested to compensate for residual consolidation within the foundation and embankment.

3 -- James M. Dale -- 11/12/68

Lorn P. Dunnigan

Subj: ENG 22-5, Missouri WP-08, Williams Creek, Site No. 1

Prepared by:


Gerald N. Gibson

Reviewed and Approved by:


Lorn P. Dunnigan

Attachments

cc:

Project Engineer, Columbia (2)
Elwin D. Butler, Lincoln

It. = 34'
55,000 cy

100-523-130
Q118
Nov. 21/63

[illegible]

DEPTH	FIELD CLASSIFICATION	GRAIN SIZE DISTRIBUTION EXPRESSED AS PERCENT FINER BY WEIGHT														MECHANICAL ANALYSIS				ATTENDING LABS		UNITED STATES STANDARD GRADE	DIS. (PERCENT)	RELATIVE DENSITY RELATIONSHIPS IS STANDARD (1) MODIFIED				UNDISTURBED SAMPLE DATA		G _s	SPEC. GRAVITY																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
		FINES						SAND								GRAVEL								UNITED STATES STANDARD GRADE	DIS. (PERCENT)	RELATIVE DENSITY RELATIONSHIPS IS STANDARD (1) MODIFIED	UNDISTURBED SAMPLE DATA																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													
		0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075							0.075	0.075			0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075

MATERIALS TESTING REPORT	U. S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE	COMPACTION AND PENETRATION RESISTANCE
-------------------------------------	--	--

PROJECT AND SITE <u>Williams Creek #1</u>	LOCATION <u>Missouri</u>
--	-----------------------------

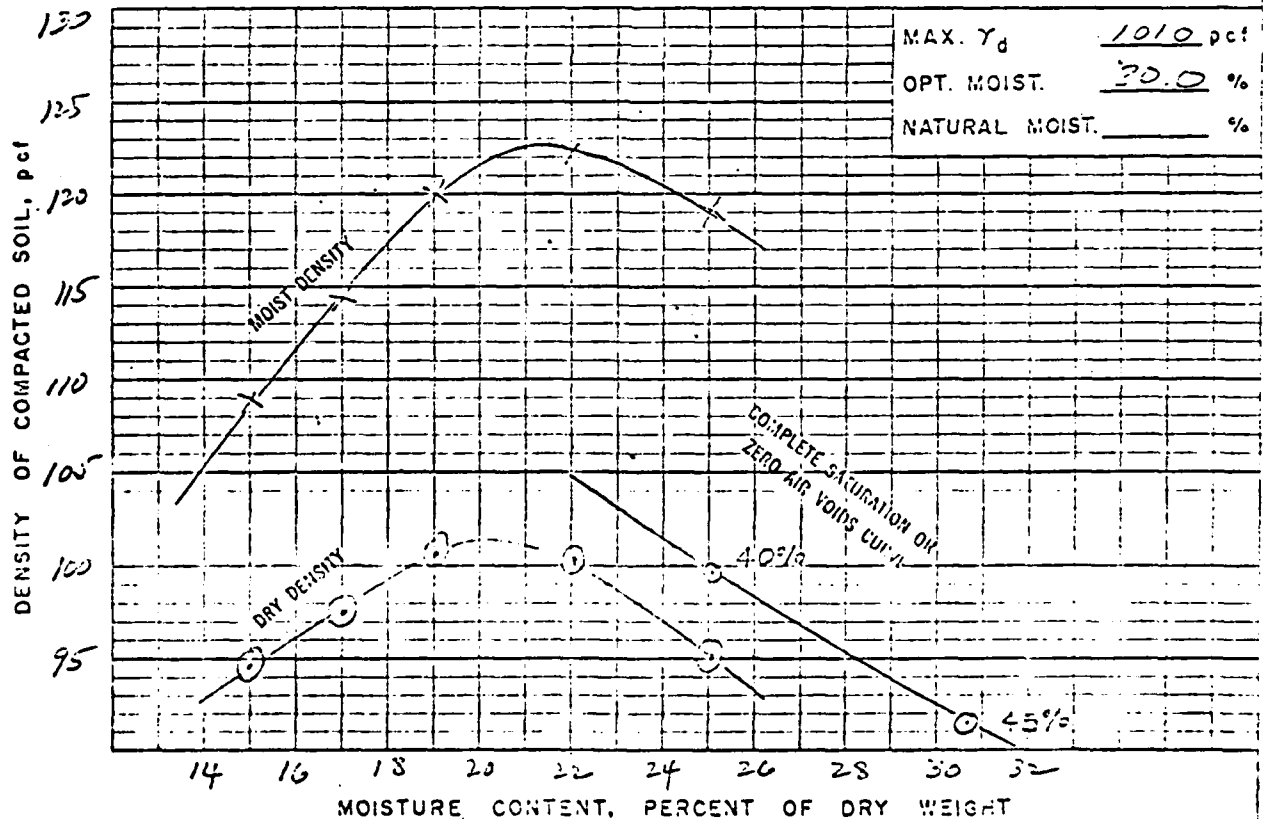
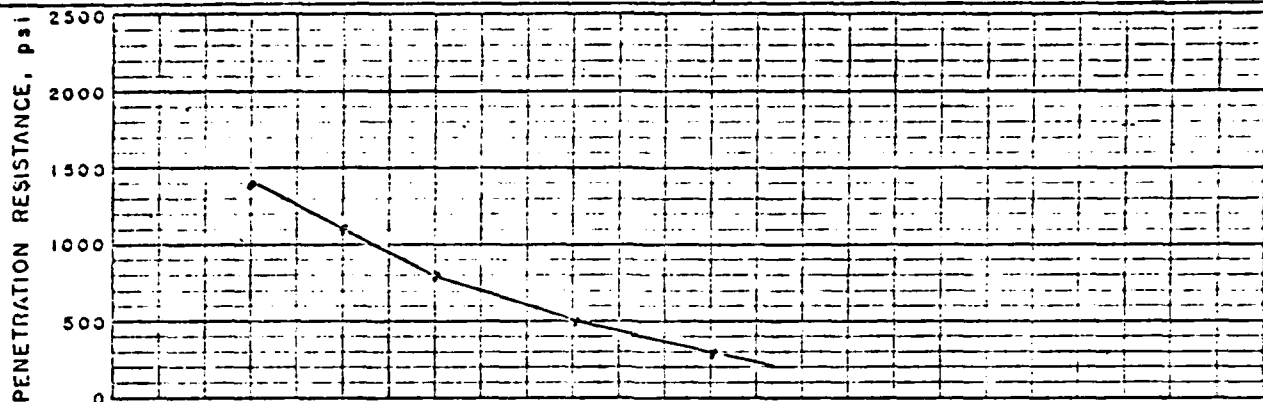
FIELD SAMPLE NO. <u>201</u>	LOCATION <u>E Emer. Spwy. 4490</u>	DEPTH <u>1.5-6.0'</u>
--------------------------------	---------------------------------------	--------------------------

GEOLOGIC ORIGIN <u>Till</u>	TESTED AT <u>SML-LINCOLN</u>	APPROVED BY <u>[Signature]</u>
--------------------------------	---------------------------------	-----------------------------------

CLASSIFICATION <u>CL</u> LL <u>47</u> PI <u>25</u>	CURVE NO. <u>1</u> OF <u>5</u>
--	--------------------------------

MAX. PARTICLE SIZE INCLUDED IN TEST <u>2 #4 "</u>	STD. (ASTM D-698) <input checked="" type="checkbox"/> METHOD <u>A</u>
---	---

SPECIFIC GRAVITY (G_s) { MINUS NO. 4 <u>2.66</u> PLUS NO. 4 _____	MOD. (ASTM D-1557) <input type="checkbox"/> METHOD _____ OTHER TEST <input type="checkbox"/> (SEE REMARKS)
--	---



MAX. γ_d	<u>1010</u> pcf
OPT. MOIST.	<u>20.0</u> %
NATURAL MOIST.	_____ %

REMARKS

U.S. DEPARTMENT OF AGRICULTURE
 TESTING REPORT SOIL CONCENTRATION SERVICE
 COMPACTION AND PENETRATION RESISTANCE

PROJECT OR STATE Williams Creek #1 Missouri

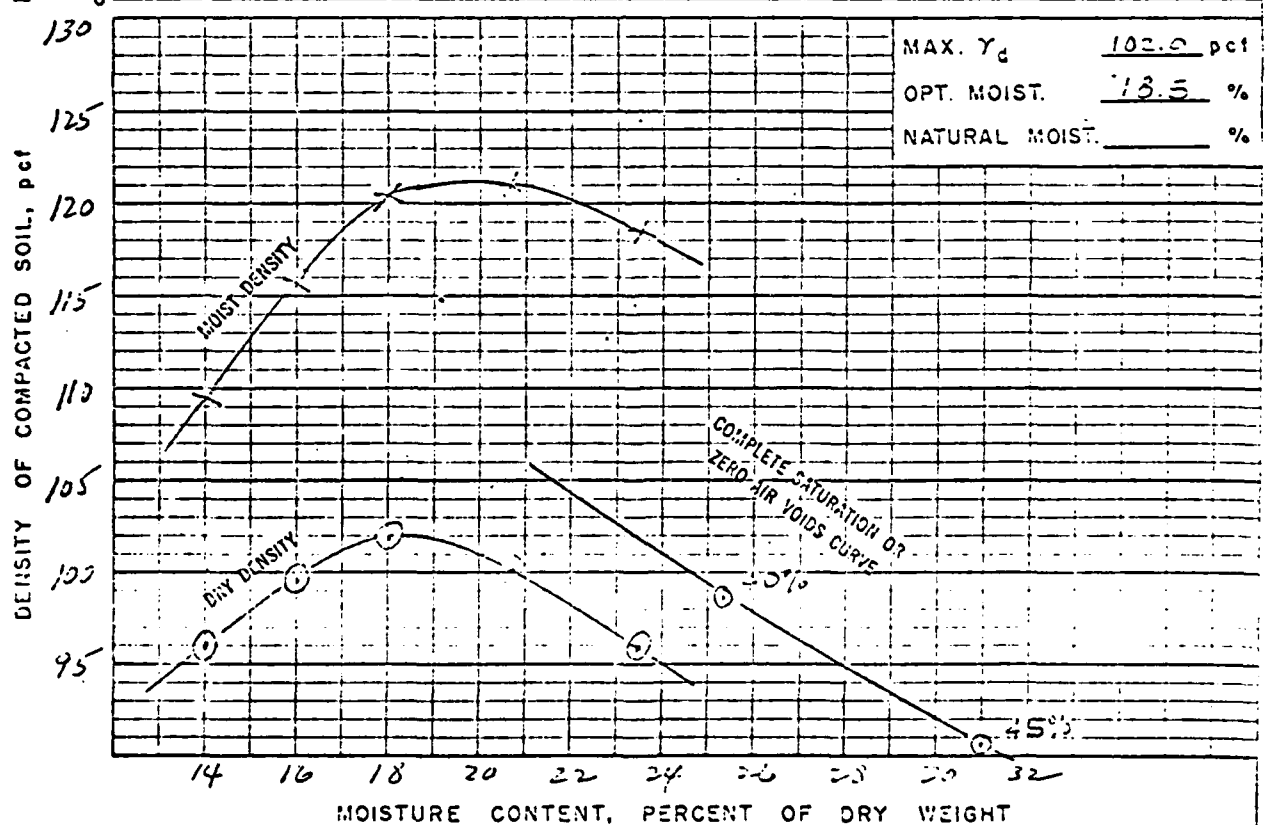
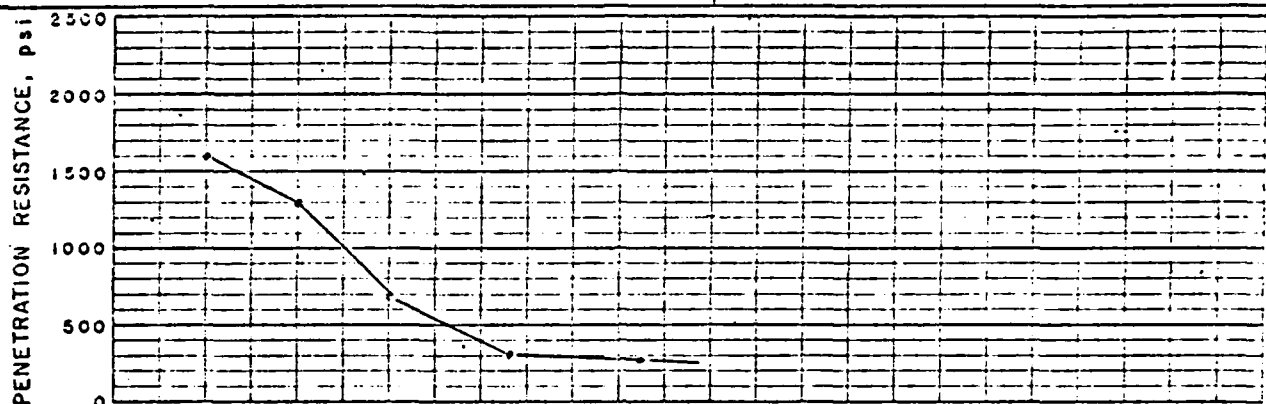
FIELD SAMPLE NO. 1011 LOCATION BORROW P+00 11+00 DEPTH 0.0-2.5'

GEOLOGIC ORIGIN CLAY TESTED AT SML-LINCOLN APPROVED BY J.H.K. DATE 11-6-63

CLASSIFICATION CL LL 37 PI 15 CURVE NO. 2 OF 5

MAX. PARTICLE SIZE INCLUDED IN TEST < #4 " STD. (ASTM D-698) ☒ METHOD A

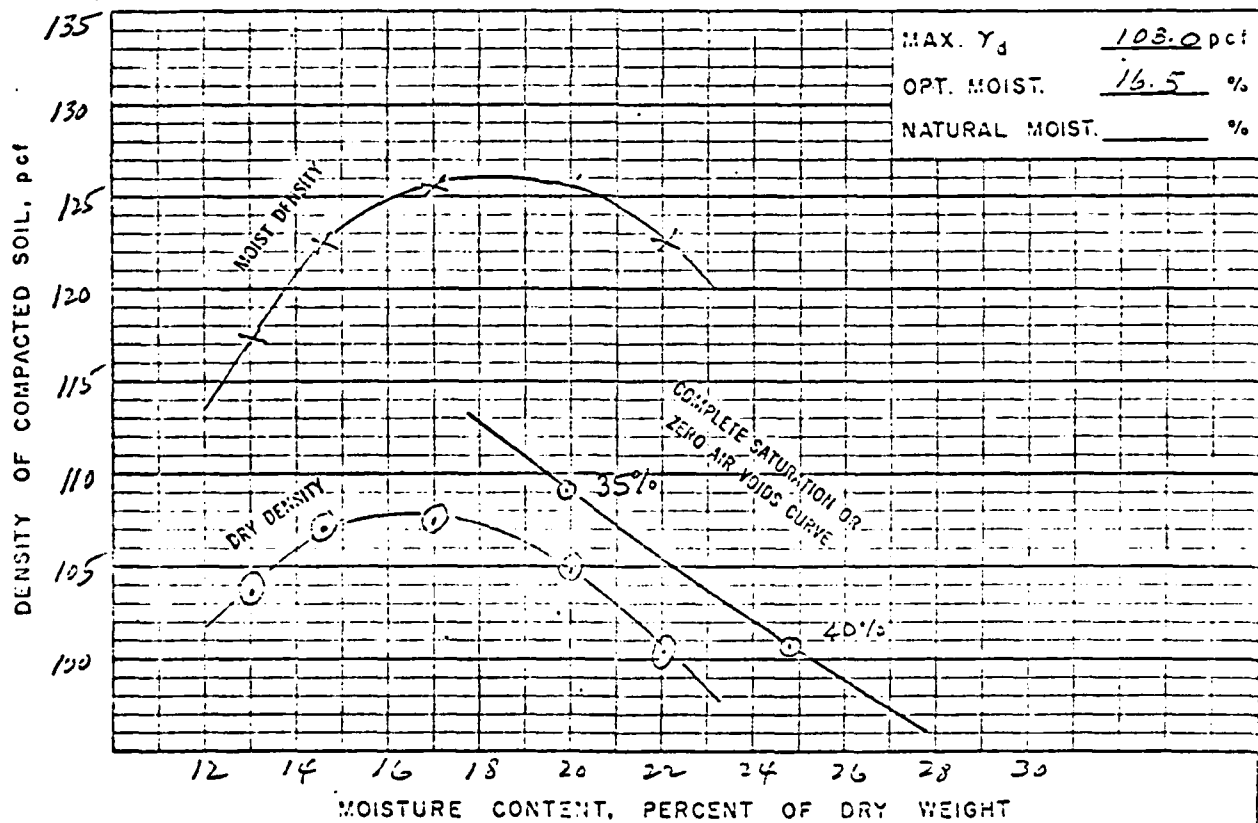
SPECIFIC GRAVITY (G_s) { MINUS NO. 4 2.63 MOD. (ASTM D-1557) ☐ METHOD
 PLUS NO. 4 OTHER TEST ☐ (SEE REMARKS)



MAX. γ_d 102.0 pcf
 OPT. MOIST. 18.5 %
 NATURAL MOIST. %

REMARKS

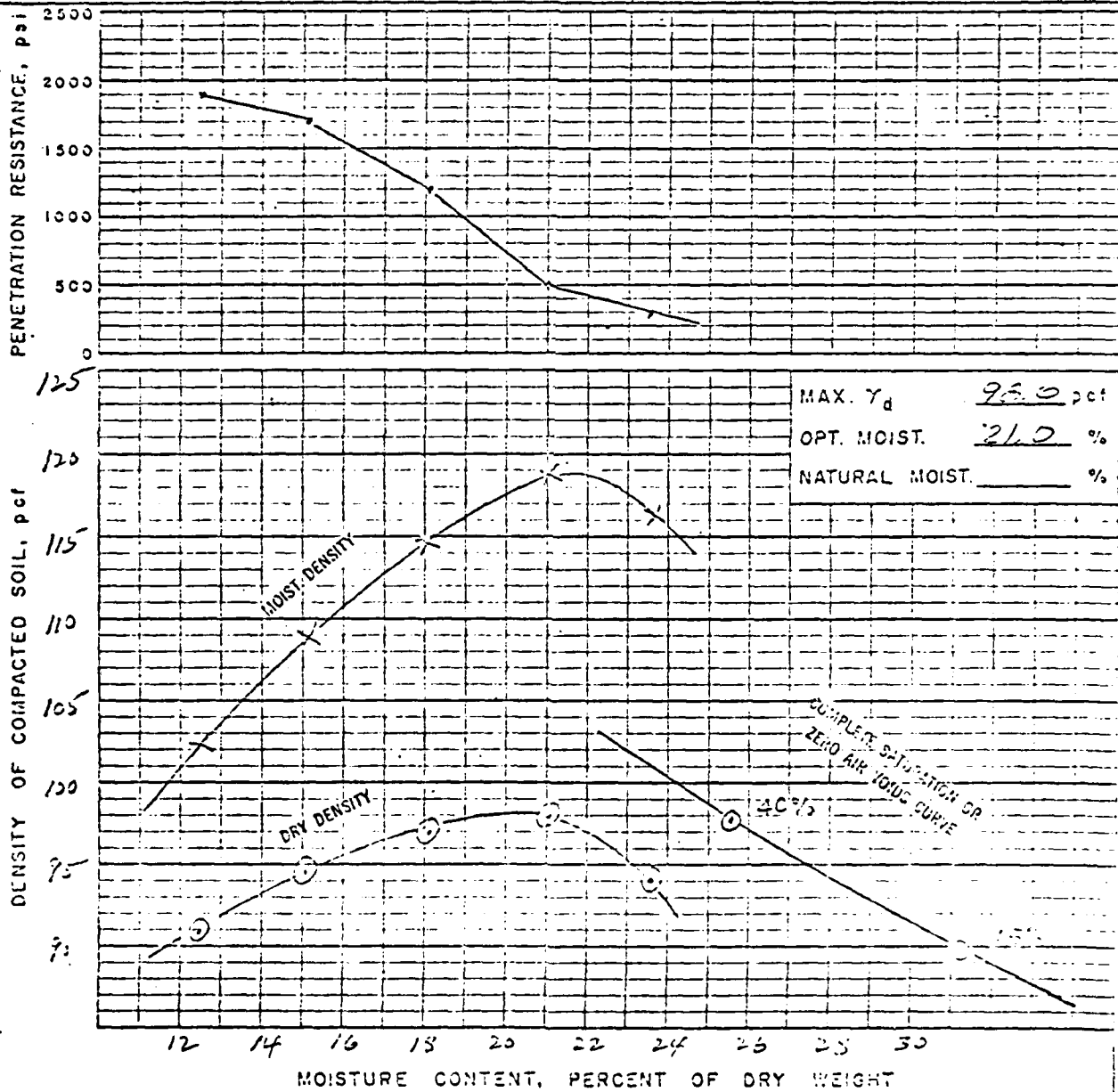
MATERIALS		U. S. DEPARTMENT OF AGRICULTURE		COMPACTION AND	
TESTING REPORT		SOIL CONSERVATION SERVICE		PENETRATION RESISTANCE	
PROJECT AND STATE: <u>Williams Creek #1 Missouri</u>					
FIELD SAMPLE NO.	LOCATION			DEPTH	
<u>101.2</u>	<u>Borrow Pit 11+00</u>			<u>2.0'-4.0'</u>	
GEOLOGIC ORIGIN	TESTED AT	APPROVED BY	DATE		
<u>Alluvium</u>	<u>SML-LINCOLN</u>	<u>A.N.H.</u>	<u>11-6-65</u>		
CLASSIFICATION <u>CL</u> <u>LL 40</u> <u>PI 22</u>			CURVE NO. <u>3</u> OF <u>5</u>		
MAX. PARTICLE SIZE INCLUDED IN TEST <u><#4</u>			STD. (ASTM D-698) <input checked="" type="checkbox"/> METHOD <u>A</u>		
SPECIFIC GRAVITY (G_s) { MINUS NO. 4 <u>2.69</u>			MOD. (ASTM D-1557) <input type="checkbox"/> METHOD <u></u>		
			PLUS NO. 4 <u></u>		
			OTHER TEST <input type="checkbox"/> (SEE REMARKS)		



MAX. γ_d 103.0 pcf
OPT. MOIST. 16.5 %
NATURAL MOIST. %

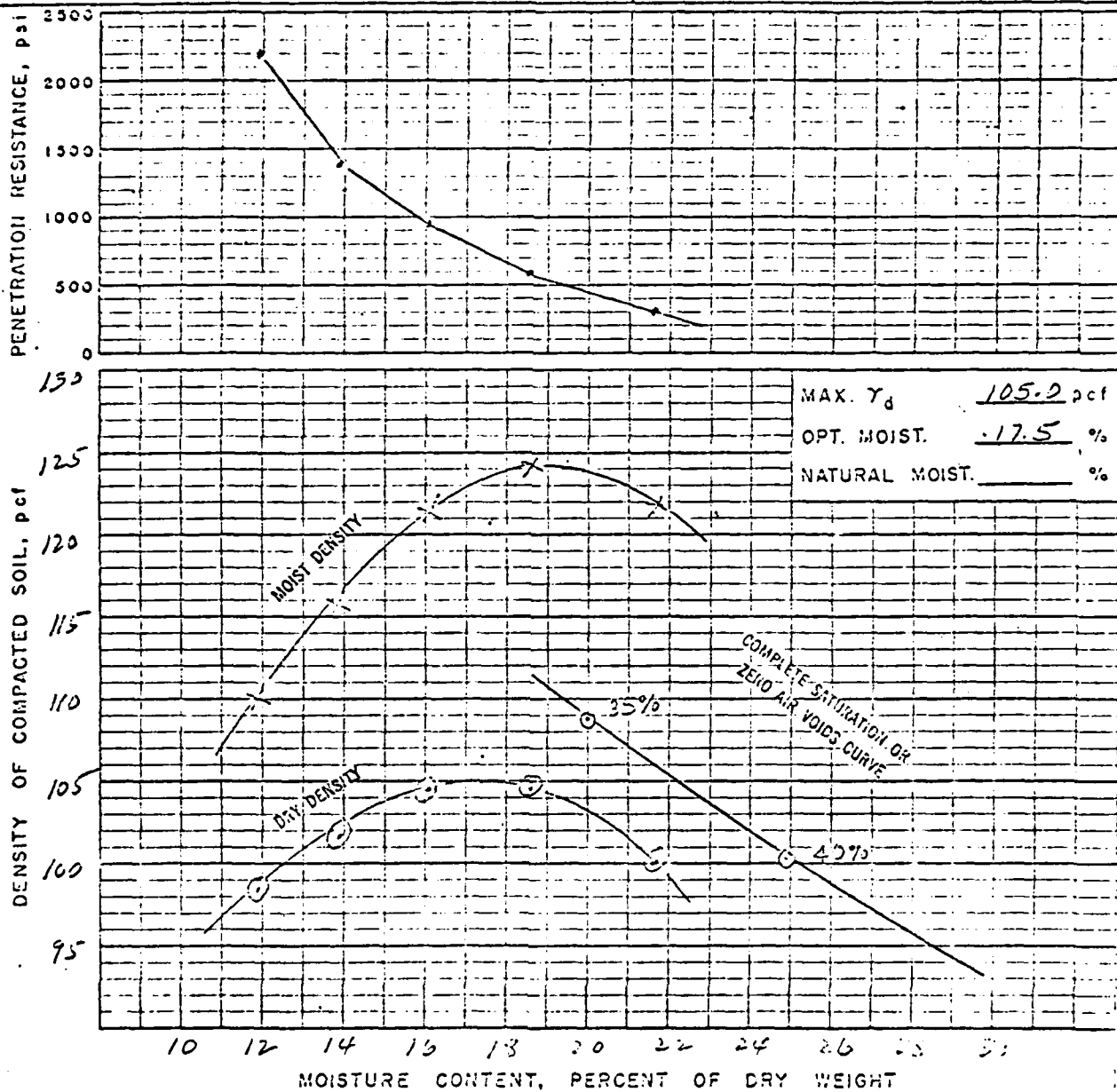
REMARKS

U.S. DEPARTMENT OF AGRICULTURE FOREST SERVICE		COMPACTION AND PENETRATION RESISTANCE	
PROJECT NO. <u>Williams Creek #1</u> <u>Muskegon</u>			
FIELD SAMPLE NO. <u>103.1</u>	LOCATION <u>Borrow D+00 A+00</u>	DEPTH <u>0.0' - 3.5'</u>	
GEOLOGIC ORIGIN <u>Alluvium</u>	TESTED AT <u>SML-LINCOLN</u>	APPROVED BY <u>H.H.</u>	DATE <u>11-6-63</u>
CLASSIFICATION <u>CL</u> LL <u>36</u> PI <u>12</u>		CURVE NO. <u>4</u> OF <u>5</u>	
MAX. PARTICLE SIZE INCLUDED IN TEST <u>< #4</u> "		STD. (ASTM D-698) <input checked="" type="checkbox"/> METHOD <u>A</u>	
SPECIFIC GRAVITY (G _s) { MINUS NO. 4 <u>2.61</u>		MOD. (ASTM D-1557) <input type="checkbox"/> METHOD <u></u>	
		OTHER TEST <input type="checkbox"/> (SEE REMARKS)	



REMARKS

STATE OF MISSOURI TESTING DIVISION		U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE		COMPACTION AND PENETRATION RESISTANCE	
PROJECT OR STATE <u>Williams Creek #1</u> <u>Missouri</u>					
FIELD SAMPLE NO. <u>102.2</u>	LOCATION <u>Barrow 0+00 9+00</u>			DEPTH <u>3.5-8.0'</u>	
GEOLOGIC ORIGIN <u>Aluminum</u>	TESTED AT <u>S.M.L. LINCOLN</u>		APPROVED BY <u>[Signature]</u>	DATE <u>11-6-63</u>	
CLASSIFICATION <u>CL</u> <u>LL 41</u> <u>PI 21</u>			CURVE NO. _____ OF _____		
MAX. PARTICLE SIZE INCLUDED IN TEST <u>#4</u>			STD. (ASTM D-698) <input checked="" type="checkbox"/> ; METHOD <u>A</u>		
SPECIFIC GRAVITY (G_s) { MINUS NO. 4 <u>2.63</u>			MOD. (ASTM D-1557) <input type="checkbox"/> ; METHOD _____		
			PLUS NO. 4 _____		
			OTHER TEST <input type="checkbox"/> (SEE REMARKS)		



REMARKS

APPENDIX D
HYDROLOGIC COMPUTATIONS

HYDROLOGIC COMPUTATIONS

1. The Mockes dimensionless standard curvilinear unit hydrograph and the SCS TR-20 program were used to develop the inflow hydrographs (see Plate D1). The inflow hydrograph for the 100-year flood was generated by the consultant using the TR-20 program.

a. Six-hour, twelve-hour, and twenty-four hour 100-year rainfall for the dam location was taken from NOAA Technical Paper 40. The 24-hour probable maximum precipitation was taken from the curves of Hydrometeorological Report No. 33 and current Corps of Engineers and St. Louis District policy and guidance for hydraulics and hydrology.

b. Drainage area = 1.642 square miles (SCS).

c. Time of concentration of runoff = 42 minutes (SCS).

d. The antecedent storm conditions were heavy rainfall and low temperatures which occurred on the previous 5 days (SCS AMCIII). The initial pool elevation was assumed at the crest of the principal spillway.

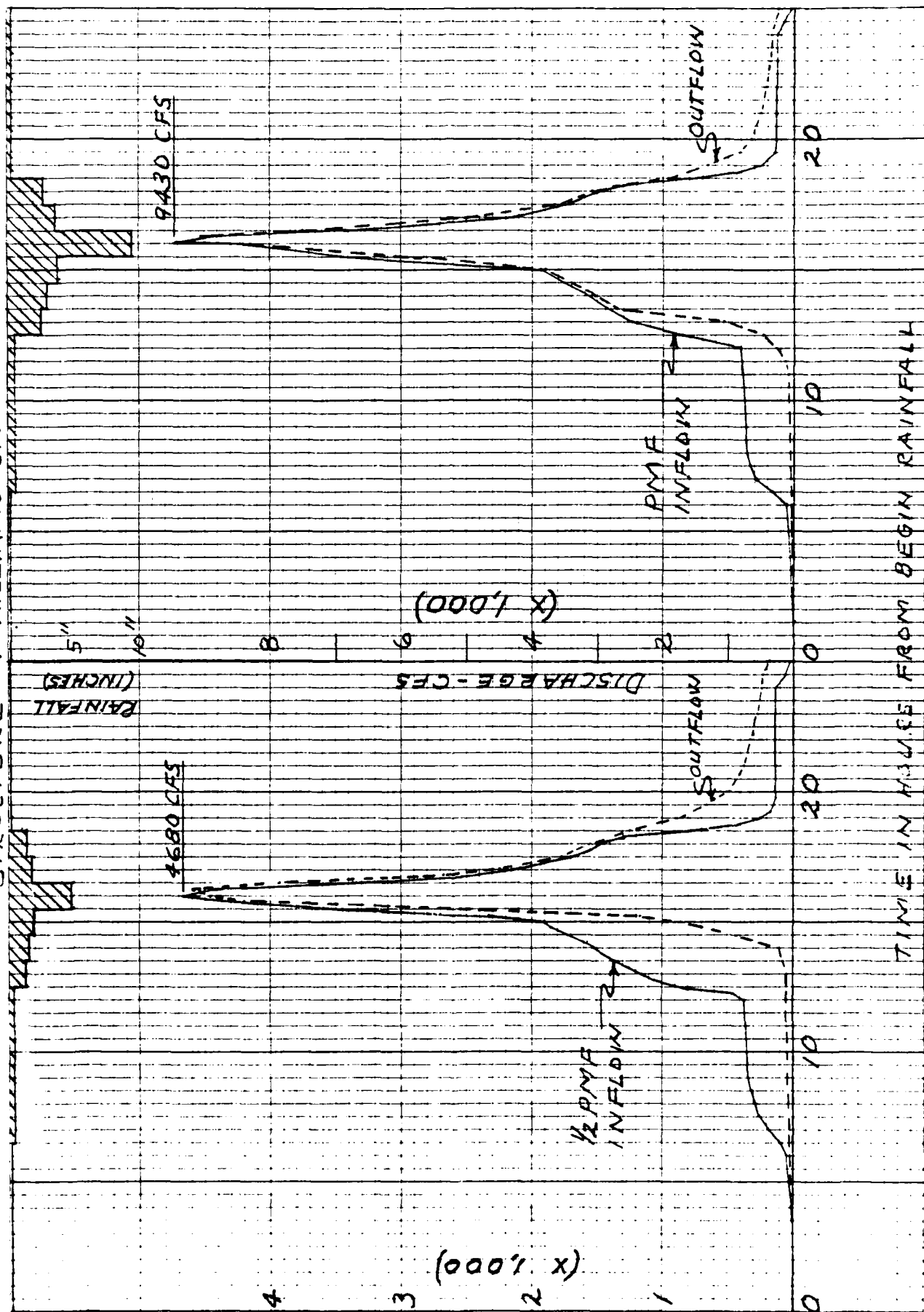
e. The total 24-hour storm duration losses for the 100-year storm were 1.08 inches. The 100-year (1 percent) peak outflow and the spillway capacity are approximately equal. The total losses for the 24-hour duration 1/2 PMF storm were 1.14 inches. The total losses for the PMF storm were 1.19 inches. These data are based on SCS runoff curve No. 91 and antecedent moisture conditions from SCS AMCIII.

f. Average soil loss rates = 0.05 inch per hour approximately.

2. The weir/orifice discharge ratings were developed using standard formulas. The emergency spillway discharge rating was developed using the upstream standard step backwater method to develop a water surface in the reservoir. The flows over the dam crest were based on the broad-crested weir equation $Q = CLH^{3/2}$, where H is the head on the dam crest; the coefficient C, which varies with head, was taken from the USGS publication "TWRI, Book 3, Chapter 5, Measurement of Peak Discharge at Dams by Indirect Methods".

3. Floods were routed through the reservoir using the TR-20 program to determine the capabilities of the spillways and dam embankment crest. The storm rainfall patterns, inflow hydrographs and routed outflow hydrographs are shown on Plate D1.

STRUCTURE #1-WILLIAMS CR.



DATE
ILME